Patent claims

1. A three-dimensional flow cell for aligning non- isometric particles in a liquid sample in two axes, comprising a feed zone for the sample containing non-isometric particles to be aligned and an outlet for the sample containing non-isometric particles aligned in two axes, a fluid element of the sample with the dimensions a, b, c being transformed in an expansion zone into a fluid element with the dimensions a x n, b/n x m, c/m, a being the width, b the height and c the length of the fluid element and n and m being constants which depend on the geometry of the flow cell and which signify positive numbers ≥ 1.

2. The three-dimensional flow cell as claimed in claim 1, wherein m x n = m^2/n or n^2 = m.

3. A method of aligning non-isometric particles in a liquid sample, the liquid sample flowing through a three-dimensional flow cell as claimed in claim 1 or 2, a fluid element of the liquid sample with the dimensions a, b, c being transformed into a fluid element with the dimensions a x n, b/n x m, c/m, a being the width, b the height and c the length of the fluid element and m and n being constants which depend on the geometry of the flow cell and which signify positive numbers ≥ 1.

4. The method as claimed in claim 3, wherein $m + n = m^2/n$ or $n^2 = m$.

5. The use of a three-dimensional flow cell as claimed in claim 1 or 2 for the two-dimensional alignment of non-isometric particles in a liquid sample in two axes, preferably for the alignment of non-isometric particles in liquid pigment preparations.

6. A photometric measuring device for measuring the level of attenuation in the propagation of light in a liquid sample containing non-isometric particles, comprising a three-dimensional flow cell for aligning the particles in the liquid sample in two axes as claimed in claim 1 or 2.

7. The photometric measuring device as claimed in claim 6, wherein it is a reflectance sensor.

8. The reflectance sensor as claimed in claim 7, built up from

a) an optical unit (A), which comprises

aa) a light source (Aa) in the form of a lamp, and

ab) an optical waveguide (Ab) comprising fiber optics, at least one optical waveguide being a reference waveguide,

b) a sample analysis unit (B), which comprises

ba) a measuring window (Ba), and

bb) a sample analysis cell with three-dimensional flow cell (Bb),

the optical unit being arranged on one side of the measuring window and the sample analysis cell with three-dimensional flow cell being arranged on the other side of the measuring window, by said cell being pressed against the measuring window in such a way that a gap is formed between the measuring window and sample analysis cell, which gap a liquid sample to be measured containing non-isometric particles must traverse, the liquid sample to be measured being led up to the gap through the three-dimensional flow cell, which is arranged upstream of the gap, in a special flow guide,

and

c) a system control unit (C) comprising detectors (Ca) for recording measured data and an evaluation device (Cb) connected thereto,

at least one optical waveguide connection being led from the light source (Aa) to the measuring window (Ba) and from the measuring window (Ba) onward to the detector (Ca), to generate a measured signal, and at least one reference waveguide connection being led directly from the light source (Aa) to the detector (Ca) or from the measuring window (Ba) to the detector (Ca), to generate a reference signal.

9. The reflectance sensor as claimed in claim 7 or 8, wherein the lamp is selected from the group comprising LEDs, gas discharge lamps and lamps with incandescent filaments.

10. The reflectance sensor as claimed in one of claims 7 to 9, wherein the lamp has an integrated shutter.

11. The reflectance sensor as claimed in one of claims 7 to 10, wherein the optical waveguides are fibers of 100, 200, 400, 600 or 800 μm fiber diameter.

12. The reflectance sensor as claimed in one of claims 7 to 11, wherein the fiber used as a reference waveguide has a matched, preferably smaller, diameter than the remaining optical waveguides.

13. The reflectance sensor as claimed in one of claims 7 to 12, wherein it additionally has at least one of the following features:

ac) arranged behind the lamp is a compensation filter, which linearises the spectrum of the lamp in such a way that the difference between the highest and lowest intensity of the light emitted by the lamp is as small as possible, for example a maximum of a factor 4,

ad) arranged behind the lamp - between lamp and compensation filter if a compensation filter is used - are an IR blocking filter, a condenser and a diffuser,

ae) the optical waveguides are guided in protective tubes and are supported over their entire length by means of a supporting frame,

af) the reference waveguide is led via a precise spacing element with incorporated diffuser, and attenuated in a defined manner.

14. The reflectance sensor as claimed in one of claims 7 to 13, wherein the measuring window a planar plate, preferably a planar plate of glass, semi-precious stones or diamond, particularly preferably of 1 to 20 mm thickness and 40 to 100 mm diameter.

15. The reflectance sensor as claimed in one of claims 7 to 14, wherein the gap is 2 to 10 mm long and between 0.05 and 5 mm high.

16. The reflectance sensor as claimed in one claims 7 to 15, wherein, during the traverse of the liquid sample containing particles, considerable shearing of the sample takes place, which is preferably achieved by means of a pressure drop from the inlet point of the sample into the gap as far as its outlet point of 0.1 to 3 bar over 2 to 10 mm length.

17. The reflectance sensor as claimed in one of claims 7 to 16, wherein the sample analysis cell (Bb) is removable.

18. The reflectance sensor as claimed in one of claims 7 to 17, wherein the system control unit has detectors in the form of fiber-optic monolithic diode line sensors which permit a resolution of at least 15 bits.

19. The reflectance sensor as claimed in one of claims 7 to 18, wherein all the units of the reflectance sensor are accommodated in a common housing, in which ventilation and thermostat-regulated heat dissipation are carried out.

20. A method of measuring the reflectance of a liquid sample containing non-isometric particles, comprising:

i) forming a sample stream of a sample containing non-isometric particles with a defined thickness and defined alignment of the particles in the sample in two axes,

ii) irradiating the sample stream at one or more angles with electromagnetic radiation emitted by a light source, the electromagnetic radiation interacting with the sample and some of the radiation being reflected diffusely following interaction with the sample,

iii) receiving and registering the diffusely reflected radiation as a reflectance signal at a plurality of angles,

iv) receiving and registering a reference signal, the reference signal being electromagnetic radiation which is emitted by the same light source used to irradiate the sample stream but which does not interact with the sample,

the reflectance signal and the reference signal being registered simultaneously.

21. The use of a reflectance sensor as claimed in one of claims 7 to 19 for measuring the reflectance of a liquid sample containing non-isometric particles, preferably a liquid sample in the form of a liquid pigment preparation containing non-isometric particles.

22. The use of a reflectance sensor as claimed in one of claims 7 to 19 for the reflectance measurement of liquid pigment preparations containing non-isometric particles at any desired process stage during the production, further processing and use of liquid pigment preparations, for quality assessment during coating production, for controlling a metering system during the production of coatings by mixing various liquids, for automatically regulated color adjustment by means of tinting during coating production, for matching the color of the coating in a coating installation which has a metering system for color pastes, for monitoring subsequent color changes as a result of ageing or shear stressing of pigmented coatings or pigment pastes or for monitoring product quality in ring mains of ring main installations.